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THE EPIDEMIOLOGY OF INFLUENZA.¹

By W. H. Frost, Surgeon, United States Public Health Service.

The history of influenza, so far as it is known, that is, for several centuries, comprises a series of long cycles in which great pandemics alternate with periods of relative quiescence, the length of cycles as measured by the intervals between pandemics being usually a matter of decades. The special characteristics of influenza pandemics are their wide and rapid extension, their high attack rates, and their great effect upon general mortality rates. Since these cycles are undoubtedly of fundamental significance in the natural history of influenza, any proper discussion of the epidemiology of the disease should cover at least one full cycle, preferably the last, from 1889 to the present. The material for such a discussion must, however, be collected from many and diverse sources and laboriously fitted together, since there is no concrete, specific, and continuous record of the prevalence or mortality of influenza during such a period of years.

Lack of Specific Records.

During great epidemics there are abundant, if not exact, records of prevalence, and the resulting mortality can be determined with fair precision, even though a large proportion of the deaths are classified under diagnoses other than influenza. In the intervals between epidemics influenza becomes inextricably confused with other respiratory diseases, having a general clinical resemblance but no definite etiological entity, so that the record of prevalence and even of mortality is virtually lost. The first requisites for epidemiological study, namely, clear differential diagnosis and systematic records of occurrence, are therefore lacking in influenza.

In the absence of these essential records, statistics of mortality from the group comprising influenza and all forms of pneumonia afford, perhaps, the nearest approximation to a record of influenza. It is not intended to suggest that the mortality from this group of

¹ Read at joint meeting of sections on Pharmacology and Therapeutics, Pathology and Physiology, and Preventive Medicine and Public Health, of the American Medical Association, at Atlantic City, June 13, 1919. This paper was published in the *Journal of the American Medical Association*, vol. 73, No. 5, Aug. 2, 1919, pp. 313-318.

diseases furnishes in any sense a *measure* of the prevalence of influenza, but only that it furnishes an *index*, since it is well established that the epidemic prevalence of influenza markedly affects the mortality from this group of diseases, and since it is at least probable that even in nonepidemic periods there may be some intimate and constant relation between the prevalence of influenza and the mortality from pneumonia.

The following discussion, which is necessarily confined to a few broad outlines, is, accordingly, based on records of mortality from influenza and pneumonia for a series of years, statistics of general mortality during the recent epidemic, and limited morbidity statistics.

Influenza and Pneumonia Mortality in Massachusetts, 1887-1916.

Table I and Chart 1 show for Massachusetts, a State in which continuous records are available, the number of deaths and the death rates per 100,000 from influenza and from all forms of pneumonia, by months, from 1887 to 1916, inclusive.

TABLE 1.—*Death rates per 100,000 of population from pneumonia (all forms) and from influenza in Massachusetts, 1887-1916, inclusive.*

PNEUMONIA.

Year.	Total per year.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1887.....	138.8	19.5	16.7	1.9	22.6	16.1	7.7	5.5	4.1	5.6	9.0	14.8	15.3
1888.....	172.7	24.7	25.1	26.4	21.3	16.4	8.0	5.5	4.0	6.2	11.4	9.8	13.9
1889.....	156.6	17.9	16.3	21.1	19.8	14.9	7.5	5.3	5.2	5.4	10.6	13.2	19.3
1890.....	180.0	47.8	17.7	17.6	20.1	12.7	8.5	6.2	4.8	5.0	9.4	11.8	18.3
1891.....	188.5	20.6	16.4	20.6	25.1	23.9	10.1	5.9	4.0	4.0	7.7	13.8	36.4
1892.....	213.0	61.5	25.2	23.1	21.4	17.0	8.3	5.4	4.2	6.8	8.5	12.5	19.0
1893.....	225.8	27.3	25.4	28.6	33.1	27.3	11.1	8.0	5.0	6.1	9.8	14.3	31.9
1894.....	166.0	32.8	19.9	22.7	18.5	14.0	8.5	5.1	5.1	6.8	8.2	11.3	13.6
1895.....	184.1	19.1	34.4	30.8	20.9	14.4	7.6	5.6	5.3	4.7	10.5	13.4	17.3
1896.....	182.0	19.5	20.7	24.9	25.9	18.7	10.3	7.6	4.5	7.6	10.7	12.7	18.8
1897.....	181.6	21.1	24.9	31.5	19.7	15.2	10.2	7.0	4.5	6.0	11.7	13.1	16.9
1898.....	156.0	18.8	17.1	18.5	18.7	15.7	6.6	6.0	4.8	5.6	10.6	12.8	21.0
1899.....	181.3	37.5	25.8	20.6	18.4	14.0	8.9	5.0	4.8	5.8	8.2	13.2	19.0
1900.....	188.3	22.7	21.1	42.0	30.5	17.6	8.7	5.3	4.3	5.3	6.2	9.9	14.7
1901.....	167.7	22.6	26.6	26.2	19.9	13.9	7.7	3.4	3.4	5.7	9.1	14.2	15.1
1902.....	158.9	15.7	18.9	19.9	16.8	15.5	8.0	6.2	5.3	5.7	11.8	14.5	20.6
1903.....	172.5	25.2	25.8	25.4	18.1	16.8	8.2	7.0	4.5	4.6	7.7	13.3	18.9
1904.....	172.1	22.6	22.7	24.1	21.2	14.2	6.7	5.9	4.4	6.5	9.4	15.0	19.5
1905.....	178.3	24.7	27.7	23.6	17.1	15.5	8.5	5.4	4.8	6.2	8.9	15.8	20.0
1906.....	174.1	22.5	24.9	24.1	21.7	14.9	5.1	6.2	5.0	6.0	9.4	13.8	21.0
1907.....	180.4	25.5	24.4	23.4	18.3	14.3	9.5	5.1	5.1	7.1	9.3	12.7	26.9
1908.....	165.8	26.6	22.2	21.1	19.4	13.5	6.6	4.9	5.8	6.4	9.2	12.4	17.6
1909.....	170.3	22.1	20.0	20.1	20.1	16.0	9.7	5.1	5.0	5.4	8.9	13.6	18.3
1910.....	197.6	24.1	20.7	27.5	23.3	16.9	9.7	7.3	6.3	9.1	12.3	17.0	23.6
1911.....	174.4	22.6	27.1	23.9	20.2	16.9	7.2	6.7	6.1	6.7	9.0	11.8	16.2
1912.....	152.0	19.8	20.2	21.2	16.4	13.3	6.2	5.0	4.1	5.8	9.5	10.5	19.9
1913.....	172.2	23.5	22.8	24.9	19.3	17.1	10.7	6.2	5.4	6.7	8.3	10.4	16.8
1914.....	166.0	22.9	20.1	23.2	20.4	15.2	8.2	5.1	5.5	6.0	10.1	12.6	16.8
1915.....	176.0	17.8	19.3	28.5	27.7	13.6	6.6	7.1	5.8	6.0	8.8	9.8	22.1
1916.....	170.6	35.6	25.5	23.0	17.3	14.0	7.4	5.3	4.1	5.9	7.6	12.8	19.3

TABLE 1.—*Death rates per 100,000 of population from pneumonia (all forms) and from influenza in Massachusetts, 1887—1916, inclusive—Continued.*

INFLUENZA.

Year.	Total for year.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1887.....	0.90	0.05	0.14	0.28	0.14	0.05	.....	.....	.....	0.05	0.10	0.05	0.05
1888.....	.51	.14	.05	.05	.....	.....	.....	.....	.....	.05	.14	.....	.05
1889.....	1.23	.69	.09	.14	.14	.05	0.05	0.05	.....	.....	.09	.....	.55
1890.....	18.31	10.96	2.90	1.43	.94	.40	.36	.22	.04	.18	.22	.27	.40
1891.....	23.74	.39	.39	1.00	3.87	4.65	1.57	.52	.52	.52	.22	.26	10.08
1892.....	41.06	24.33	7.64	3.02	1.83	1.10	.72	.51	.17	.21	.38	.68	.47
1893.....	12.27	.58	.70	1.29	2.57	2.07	.46	.17	.12	.04	.....	.46	3.90
1894.....	14.97	7.41	3.16	1.33	1.69	.40	.20	.16	.08	.16	.20	.16	.36
1895.....	18.10	.79	4.50	6.97	3.29	1.11	.35	.24	.08	.08	.04	.24	.36
1896.....	5.81	.93	.62	1.16	1.05	.46	.39	.15	.12	.04	.27	.19	.43
1897.....	14.40	.83	2.42	5.68	2.50	1.02	.27	.15	.23	.15	.27	.27	.61
1898.....	8.56	.59	.59	1.56	1.39	1.48	.37	.11	.22	.07	.19	.26	1.82
1899.....	20.72	9.34	5.81	2.18	1.05	.51	.29	.07	.04	.07	.33	.18	.84
1900.....	25.27	1.21	1.50	9.20	9.23	1.85	.68	.21	.07	.11	.11	.32	.78
1901.....	18.94	4.32	6.35	4.68	1.51	.84	.46	.14	.04	.21	.18	.25	.77
1902.....	5.89	.59	.87	.90	.69	.73	.24	.21	.14	.03	.24	.45	.82
1903.....	12.65	1.57	3.08	3.66	1.61	.82	.38	.14	.10	.03	.21	.34	.70
1904.....	10.26	1.45	2.06	2.80	1.38	.78	.27	.20	.07	.10	.17	.34	.64
1905.....	14.69	2.75	4.58	3.48	1.76	.85	.30	.07	.07	.03	.63	.20	.56
1906.....	6.57	1.13	1.07	1.29	.78	.36	.06	.19	.13	.66	.16	.16	1.17
1907.....	16.13	3.61	3.48	2.28	1.04	.70	.22	.03	.03	.03	.19	.54	3.99
1908.....	10.42	4.48	2.10	1.51	.85	.31	.12	.06	.03	.19	.15	.22	.37
1909.....	7.16	.76	1.93	2.30	.88	.36	.24	.03	.....	.03	.15	.21	.27
1910.....	7.40	1.39	1.01	1.75	1.51	.53	.09	.09	.....	.03	.21	.35	.44
1911.....	4.63	.87	.96	.90	.79	.41	.03	.09	.....	.03	.12	.05	.49
1912.....	6.93	1.46	1.35	1.06	.60	.26	.20	.17	.09	.09	.26	.17	1.23
1913.....	5.75	2.00	.76	.85	.51	.34	.14	.....	.17	.14	.27	.25	.39
1914.....	3.58	.75	.39	.75	.64	.36	.14	.06	.....	.06	.03	.17	.25
1915.....	6.34	.79	.60	.98	1.88	.49	.16	.08	.05	.08	.11	.22	.87
1916.....	14.50	6.32	3.04	1.67	.75	.56	.32	.16	.13	.05	.16	.43	.89

Compiled from number of deaths as given in Registration Reports, State of Massachusetts, 1887-1916, except data for 1912, which are taken from Mortality Statistics, Bureau of the Census.

Chart 1 shows clearly the effect of the epidemic of 1889-1892, developing in three distinct phases; the first culminating in January 1890, the second in April and May 1891, and the third in January 1892. It is noted that the mortality was higher in 1891 than in 1890, still higher in 1892; and that in 1893, although no distinct epidemic occurred, the pneumonia mortality for the year was still higher than in 1892. This corresponds to the experience in England according to Parsons,¹ and apparently represents the general experience in other countries, with some differences in chronology and relative severity of the several phases of the epidemic.

As comparable statistics for Massachusetts in 1917 and 1918 are not now at hand, it is necessary to turn to other sources for the record of these years. The Bureau of the Census has very kindly furnished to the writer, from tables prepared for publication in the 1917 Mortality Statistics, the number of deaths by months during 1917 from pneumonia and influenza in certain registration States,

¹ Parsons, H. Franklin. A Further Report on the Influenza Epidemics of 1889-90, 1891 and 1891-92. Local Govt. Board. London, 1893.

and cities of over 100,000 population, thus continuing through that year the records of monthly mortality available from published Mortality Statistics from 1910 to 1916, inclusive; and has also furnished records of deaths in certain of these States and cities by months during 1918. The latter figures were compiled and submitted by State and local registrars in compliance with a special request from the Director of the Census. They are merely provisional and the Census Bureau in no way vouches for their accuracy; but they are believed to be sufficiently exact for present purposes.

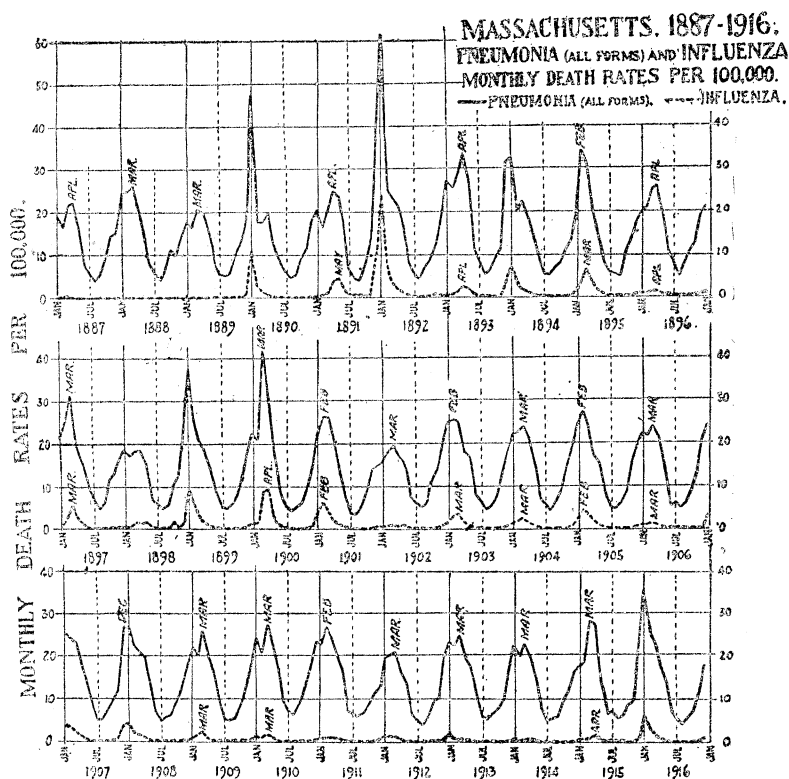


CHART 1.

Owing to the limitations of space the statistics of only three cities, New York, Cleveland, and San Francisco, are presented here. These are, however, fairly representative of the whole group of cities and States for which records are at hand. As may be seen from Table II and Chart 2 the mortality from influenza and pneumonia in these cities was fairly regular from 1910 to 1915, as was the case in Massachusetts (See Chart 1) and generally throughout the registration area of the United States.

ANNUAL DEATH RATES PER 100,000 FROM INFLUENZA AND PNEUMONIA (ALL FORMS)
BY MONTHS, 1910-1918

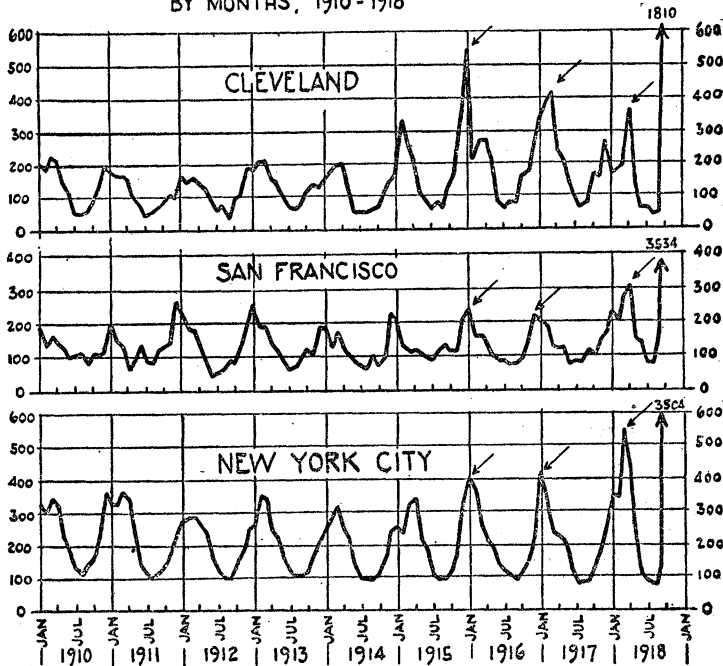


CHART 2.

TABLE II.—*Annual death rates per 100,000 of population from influenza and pneumonia (all forms) by months for the years 1910-1918, inclusive, in New York, San Francisco, and Cleveland.*

NEW YORK CITY.

Years.	Total.	Months.											
		Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1910....	229.3	327.8	300.2	343.3	303.5	225.4	162.1	125.5	108.0	126.9	154.7	211.6	365.9
1911....	217.7	321.3	325.5	359.0	338.7	237.2	137.2	115.8	97.2	107.6	145.0	195.0	240.8
1912....	198.6	206.5	294.5	287.9	254.6	238.3	153.5	112.3	99.0	94.9	157.8	178.5	251.6
1913....	199.7	265.0	353.0	342.2	242.7	225.1	158.9	113.5	101.9	100.0	118.4	172.9	213.3
1914....	184.3	247.3	293.0	319.4	241.8	211.1	131.6	92.5	86.1	88.1	110.0	162.9	234.3
1915....	202.7	253.7	232.2	325.4	344.5	212.1	172.0	103.2	89.2	90.8	120.4	167.1	324.4
1916....	189.7	402.5	261.7	252.0	210.9	194.6	133.1	113.7	100.5	87.7	116.4	154.0	242.1
1917....	191.9	417.9	316.3	237.3	221.2	202.4	122.8	72.6	78.4	89.5	127.6	185.5	237.7
1918....	636.4	348.4	339.0	548.0	432.1	201.4	105.4	81.3	71.8	3,516.0	351.6	1,259.6	549.8

SAN FRANCISCO.

1910	128.6	199.9	134.0	168.9	148.2	132.3	101.6	109.8	112.6	87.3	118.2	110.5	118.2
1911	135.7	207.3	150.0	135.6	68.6	91.2	150.0	88.5	83.0	135.0	132.7	144.0	270.9
1912	126.0	236.3	191.6	182.0	131.9	88.9	47.7	51.6	67.9	92.6	84.2	137.5	198.3
1913	139.6	261.7	192.1	104.9	143.5	122.8	91.0	66.8	72.1	99.3	125.5	110.4	194.9
1914	122.6	191.7	130.8	178.5	132.9	107.6	84.1	78.8	63.0	103.1	70.9	97.7	231.0
1915	133.2	214.6	137.4	118.8	125.4	113.6	101.4	90.4	111.0	138.7	116.2	117.4	211.8
1916	133.2	243.9	165.6	162.6	144.3	101.6	84.0	88.9	71.1	76.1	88.9	144.3	221.0
1917	127.5	210.0	185.4	130.0	121.4	125.0	72.2	80.0	77.5	113.8	100.0	144.6	167.5
1918	713.0	231.3	204.3	278.1	310.2	152.6	139.8	78.7	73.8	117.0	534.02	069.81	1351.0

TABLE II.—*Annual death rates per 100,000 of population from influenza and pneumonia (all forms) by months for the years 1910-1918, inclusive, in New York, San Francisco, and Cleveland—Continued.*

CLEVELAND.

Years.	Total.	Months.											
		Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1910....	136.3	198.3	180.0	223.0	213.5	148.3	107.9	54.2	48.2	51.8	85.6	138.0	190.0
1911....	106.5	174.3	165.9	164.1	155.0	103.4	77.5	40.5	50.6	67.1	81.0	109.0	93.2
1912....	114.6	163.6	141.2	159.7	142.7	126.2	91.7	55.2	75.0	30.6	88.8	110.1	185.4
1913....	131.9	179.8	205.1	217.5	152.5	147.4	107.5	68.1	60.6	74.3	115.3	130.9	128.6
1914....	117.2	160.1	175.2	197.0	201.8	139.9	53.3	51.6	46.3	59.0	66.4	116.0	143.7
1915....	162.7	156.5	333.1	252.6	201.8	109.3	77.4	55.5	78.8	59.2	121.8	170.2	336.3
1916....	198.5	545.0	209.2	263.8	266.9	211.2	86.6	57.6	82.1	75.7	153.6	175.0	242.9
1917....	210.9	344.0	386.0	415.0	233.8	208.0	145.8	90.2	66.4	72.1	160.0	152.9	267.0
1918....	548.0	161.3	178.5	190.4	366.3	142.6	60.0	62.5	43.5	48.0	1,812.0	2,135.0	1,376.0

Data for years 1910-1916 compiled from Mortality Statistics, Bureau of the Census, for those years. Data for 1917 from tables prepared for publication in 1917 Mortality Statistics; advance sheets furnished by the Bureau of the Census.

Data for 1918 from special reports rendered to Director of the Census by city registrars. Populations used are Bureau of the Census mid-year estimates.

Significant Rise in Mortality in December, 1915.

In December, 1915, and January, 1916, there occurred in New York and Cleveland a sudden sharp rise in mortality. This, though not shown distinctly in San Francisco, was almost universal and synchronous over the whole of the registration area. While this may have no direct significance in relation to the 1918 pandemic, it is at least of interest as indicating the operation of some definite and widespread factor and suggesting in this group of diseases an epidemic tendency which is perhaps not sufficiently appreciated. In January, 1916, influenza was reported to be epidemic in 22 States, including all sections of the United States (see Public Health Reports, Jan. 7, 1916). As this epidemic was of mild type it attracted but little attention at the time and has generally been forgotten.

Another Sharp and General Rise in Mortality in the Spring of 1918.

In the spring of 1918 there was another sharp and general rise in mortality from these diseases, clearly evident in Chart 2. In the larger cities on the Atlantic seaboard this increase occurred generally during January, February, and March, when pneumonia mortality normally reaches its maximum, and the increase was not so evident in all these cities as it was in New York City. In the rest of the country, especially in the central and western States, the increase occurred in April, a month during which pneumonia mortality is generally on the decline; and was sufficient to constitute an unmistakable departure from the normal. The increased mortality rate extended quite generally into May and in some areas still longer.

This occurrence has, I believe, a definite significance in relation to a coincident prevalence of influenza, and to the subsequent development of the influenza pandemic. Although there is no definite record

of a generalized epidemic of influenza in the United States in the spring of 1918, definite local outbreaks were observed at that time. For example, Vaughan and Palmer¹ have described a mild epidemic prevailing in the Oglethorpe camps in March. The Commissioner of Health of Chicago² states, in his special report on the autumn epidemic in Chicago, that in March, 1918, distinct epidemics resembling influenza were observed in certain groups in that city. Stanley³ in a recent publication describes three epidemics of influenza occurring in April, October, and November, 1918, respectively, in San Quentin prison, California. These three epidemics were quite similar and that of April apparently developed from a newly received inmate, presumably infected in Los Angeles, indicating the presence of the infection there at that time.

Opie, Freeman, and others of the Army Commission studying pneumonia at Camp Funston,⁴ found that recurrent outbreaks of pneumonia observed there in March, April, and May, 1918, were definitely associated with coincident epidemics of a mild type of influenza.

The rise in mortality from this group of etiologically heterogeneous diseases in the spring of 1918 is so sudden, so marked, and so general throughout the United States as to point very clearly to the operation of a single definite and specific cause, something largely independent of meteorologic and other local conditions. The observed occurrence of local epidemics of influenza at that time in widely scattered localities, the intimate association established at Camp Funston between the epidemic of influenza and pneumonia, and the subsequent development of the influenza pandemic, all indicate that the increased pneumonia mortality of March and April, 1918, was the consequence of a beginning and largely unnoticed epidemic of influenza, the beginning in this country of the great pandemic which developed in the autumn.

Mild Epidemics of Influenza in Europe in April and May, 1918.

From various localities in western Europe, mild epidemics of influenza were reported in April and May, 1918; and perhaps there may be earlier reports. During June and July extensive epidemics were reported from Great Britain, various parts of Continental Europe,

¹ Vaughan, Col. Victor C., and Palmer, Capt. Geo. T. The Communicable Diseases in the National Guard and the National Army of the United States During the Six Months from Sept. 29, 1917, to Mar. 29, 1918. Military Surgeon, Vol. XLIII, No. 4, October, 1918.

² Robertson, John Dill. A Report on an Epidemic of Influenza in the City of Chicago in the Fall of 1918. Ed. Series No. 15, Dept. of Health, City of Chicago, 1918.

³ Stanley, L. L. Influenza at San Quentin Prison, California: Public Health Reports, vol. 34, No. 19, May 9, 1919.

⁴ Opie, Eugene L., Freeman, Allen W., Blake, Francis G., Small, Jas. C., and Rivers, Thomas M. Pneumonia at Camp Funston; Report to the Surgeon General, Journal Am. Med. Ass'n, vol. 72, No. 2, Jan. 11, 1919.

China, India, the Philippine Islands, and Brazil, with marked effect on general mortality rates in such of these countries for which records are available.

Course of the 1918 Epidemic.

The course of the epidemic in England and Wales, and in the United States, respectively, is illustrated by Chart 3, which shows the annual death rates from all causes by weeks in 96 great towns of England and Wales¹ with an aggregate population (1917) of 16,577,344 and in 45 large American cities² aggregating about 22,950,000 population (1918).

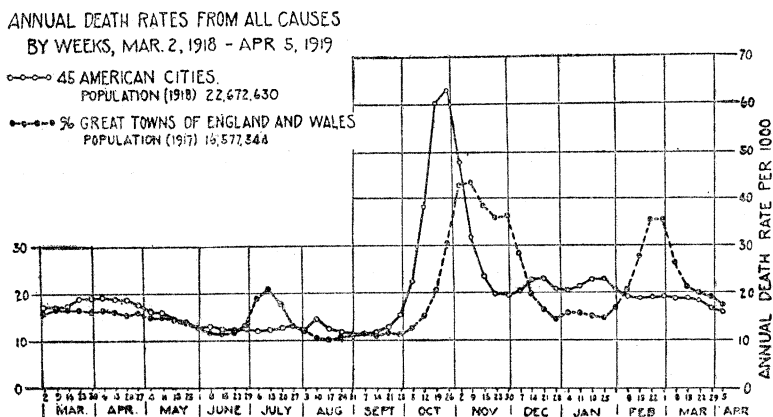


CHART 3.

In the British cities the epidemic has so far manifested three distinct waves—the first and slightest in point of mortality occurring in June and July, the second and most severe in November, the third in February and March. Data which need not be cited here in detail indicate that the course of the epidemic in western Europe generally was similar. In cities of India the sequence was similar but the mortality far greater. In the United States the epidemic developed more largely in a single wave during September, October, and November. If, however, the epidemic already mentioned as occurring in the spring be considered the first phase and the explosive outbreak of the autumn the second, a third phase or recrudescence is quite evident in many areas, though not shown distinctly in Chart 3, in which are combined a number of widely separated cities whose curves overlap. In general, this winter recrudescence was less marked in those cities which suffered most severely in the autumn epidemic.

¹ Weekly Return of Births and Deaths Registered in London and Ninety-five other Great Towns of England and Wales, London.

² Weekly Health Index, Bureau of the Census, Washington, D. C.

The course of the epidemic in the United States since September is already well known and need not be discussed here in detail. The prevalence of a serious epidemic in the civilian population was first recognized in and around Boston about the first of September. Within about two weeks the epidemic was general in cities on the Atlantic seaboard, developing a little later among the cities farther west. Rural districts were usually attacked somewhat later than large cities in the same sections. The sequence of the epidemic in three cities—Boston, Washington, and San Francisco—is shown in Chart 4. The interval between the peaks of the epidemic in Boston and San Francisco is four weeks, which is approximately the maximum difference between any two large cities in this phase of the epidemic.

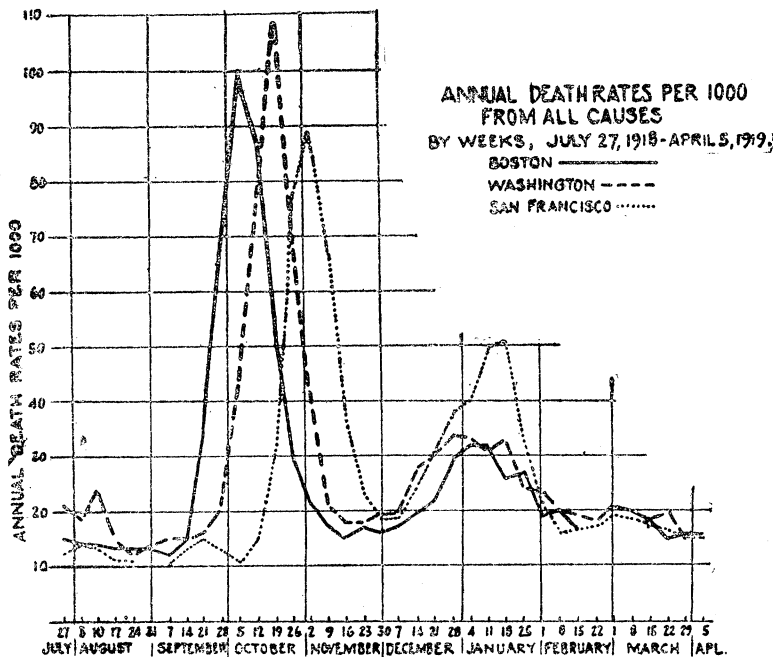


CHART 4.

The curves of mortality differed widely in different cities, as illustrated in Chart 5, showing in Philadelphia a very explosive and abrupt curve, observed more frequently among cities on the eastern seaboard; in New York a less explosive curve, with a more prolonged high mortality rate, as observed more commonly in middle western cities, often with a more pronounced recrudescence; in St. Louis a still more gradual curve, declining only slightly after the first wave, and with a severe recrudescence, curves of this general character being more common in the Middle West.

Total Number of Deaths Among the Civil Population.

Based on incomplete statistics, which represent, however, all the main geographic divisions of the country, including both urban and rural populations, the deaths in the civil population of this country directly attributable to the epidemic are estimated at not less than

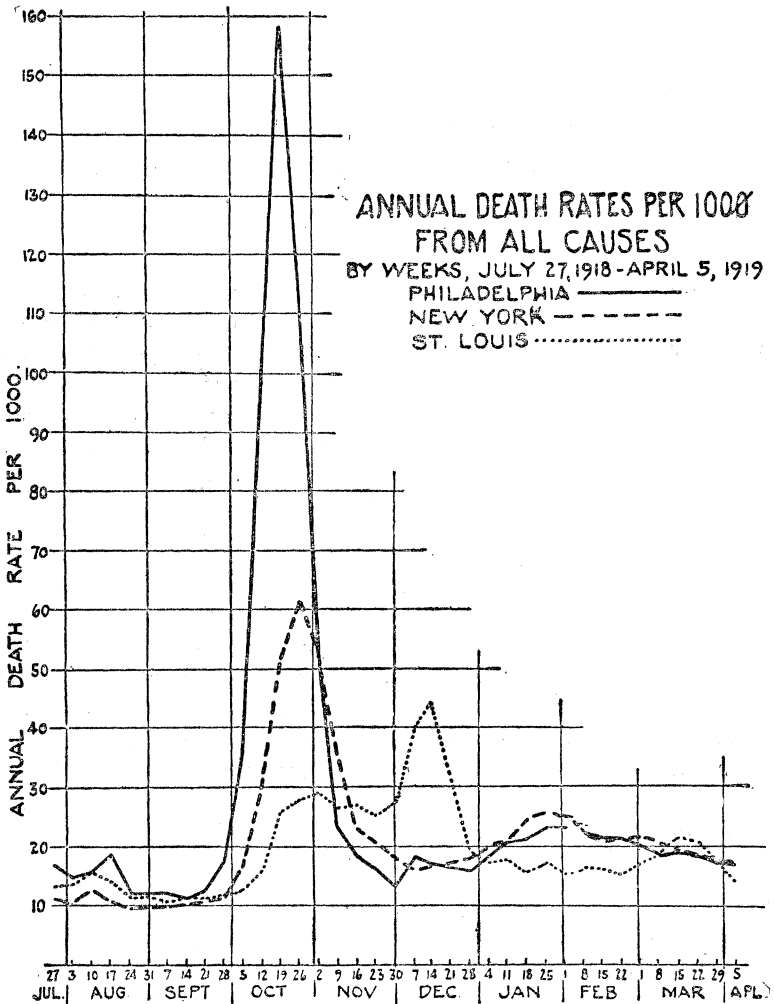


CHART 5.

450,000, or more than 4 per thousand. This rate exceeds even a liberal estimate of the net excess mortality rate in Massachusetts during the four years, 1890-1893, following the influenza outbreak in 1889-90.

Difference in Mortality in Various Geographic Groups.

Classifying the 45 cities of the Weekly Health Index into three broad geographic groups there is a noticeable difference in mortality. In the cities east of the line of the Appalachians the excess mortality from pneumonia and influenza during the weeks ended September 14, 1918, to March 1, 1919,¹ was approximately 5.6 per 1,000; in cities between the Rocky Mountains and the Appalachians 4.35; and in those of the Pacific coast 5.55 per 1,000.

Notwithstanding this general geographic relation, there are notably wide differences in the mortality rates of individual cities in the same section, even between cities close together, differences which are not as yet explained on the basis of climate, density of population, character of preventive measures exercised, or any other determined environmental factor.

More intimate details of epidemiology can be given only the briefest mention here. In order to secure reliable statistics of morbidity the Public Health Service has made special house-to-house surveys in a number of localities,² ascertaining the number of persons affected, the dates of onset, and a few other simple facts in accurately enumerated groups representative of the general population. Partial analysis of the results of these surveys in eight localities,³ giving an aggregate of 112,958 persons canvassed, shows the following as the chief facts of interest:

Results of House to House Surveys.

The percentage of the population attacked varied from 15 per cent in Louisville to 53.3 per cent in San Antonio, Texas, the aggregate for the whole group being about 28 per cent.⁴ This agrees with scattered observations in the first phase of the 1889-90 epidemic, when the attack rate seems to have varied within about these limits.

The case incidence was found to be uniformly highest in children from 5 to 14 years old, and progressively lower in each higher age group. It was slightly higher in females than in males of corresponding age; usually higher in the white than the colored population.

The ratio of pneumonia cases to total population varied from 5.3 cases per 1,000 in Spartanburg, S. C., to 24.6 per 1,000 in the smaller towns of Maryland. The pneumonia rate showed little correlation with the influenza attack rate.

The ratio of deaths to population varied from 1.9 per 1,000 in Spartanburg to 6.8 in Maryland towns. The death rate was by no

¹ United States Census Bureau, Weekly Health Index, Mar. 1, 1919. "Summary, Influenza Epidemic."

² For a description of methods and more detailed statistics of certain localities see Public Health Reports. Volume 34, No. 11, pp. 491 to 504.

³ Data from surveys of population groups as follows: New London, Conn., 7,993; Baltimore, Md. 33,361; certain smaller towns and rural districts in Maryland, 12,669; Spartanburg, S. C., 5,257; Louisville, Ky., 12,602; Little Rock, Ark., 9,920; San Antonio, Tex., 12,534; San Francisco, Calif., 18,682.

⁴ The surveys were made mostly during December, after the first wave of the epidemic had subsided, but before the second wave. Later figures would add somewhat to the incidence.

means parallel to the influenza attack rate, but was correlated closely with the pneumonia rate. In other words, the case fatality of pneumonia tended to be fairly constant, around 30 per cent, except in San Antonio, where it was only 18.5 per cent. The death rate was notably high in children under one year old, in adults from 20 to 40, and in persons over 60; higher in males than in females of comparable ages; higher in the white than in the colored.

The case fatality was likewise higher in these age groups, under one year, 20 to 40, and over 60 years; and it is this fact, rather than the incidence rates, which determines the death rates in different age groups.

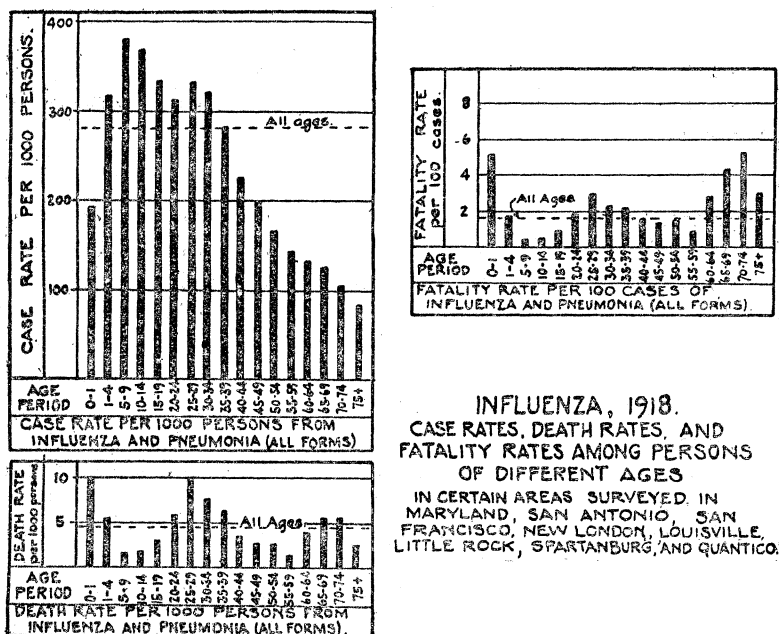


CHART 6.

Chart 6, shows the attack rates, death rates and case fatality rates in various age groups.

The Important Question of Immunity.

Concerning the important question of the immunity conferred by an attack of influenza, the evidence is not conclusive, chiefly because of the uncertain differentiation between influenza and other infections. Parsons, from his study of the last epidemic,¹ inclines to the view that an attack of influenza in the earlier years of the epidemic conferred a considerable but not absolute immunity in the later outbreaks.

¹ Loc: cit.

In Baltimore, where our first canvass of 33,776 people was made between November 20 and December 11, 1918, a second canvass of the same population was made in January to determine the extent of the recrudescence reported in December. Among 32,600 people included in this canvass, 724 cases of influenza were found to have occurred since the previous survey. Of this number, 121 cases were reported as second attacks, but on investigation through the attending physicians or by a medical officer, the clinical diagnosis of both attacks as influenza was confirmed in only 26 cases, or 0.37 per cent of the total, and even in these cases the diagnosis is necessarily uncertain. Considering that 23 per cent of the population had had influenza prior to December 11, the proportion of second attacks should have been much greater if no immunity had been acquired. A second canvass in San Francisco gave generally similar results. The data collected for a study of this question from other angles have not yet been analyzed.

General Characteristics of Epidemic.

In general this epidemic has been quite similar to that of 1889-90 in its early development, first in mild scattered outbreaks, later in a severe world-wide epidemic; in the rapidity of its spread and in its high case incidence. It has been notably different in a much higher frequency of pneumonia and consequently much higher mortality, especially among young adults.

Such evidence as has been collected confirms the conclusion previously reached that the infection is transmitted directly by "contact" in the broad sense. It appears probable, however, that the infection was already widely disseminated in this country some time before a serious epidemic was recognized.

Probability of Recurrence in the Near Future.

The question of most practical and immediate interest is the probability of recurrence in the near future. Recurrences are characteristic of influenza epidemics; and the history of the last pandemic and previous ones would seem to point to the conclusion that this one has not yet run its full course. On the other hand this epidemic has already shown three more or less distinct phases and has been more severe, at least in mortality, than the three-year epidemic of 1889-92, facts which may justify the hope, though not the conclusion, that it has run its course already.

It seems probable, however, that we may expect at least local recurrences in the near future, with an increase over the normal mortality from pneumonia for perhaps several years; and certainly we should be, as far as possible, prepared to meet them by previous organization of forces and measures for attempted prevention, treatment, and scientific investigation.

Future Study and Control.

As regards preventive measures, the efficacy of those carried out in recent months is not proved, and we can only continue to follow the apparently sound principles already applied. It seems hardly logical to expect that any measure short of effective specific immunization will afford lasting protection to the general population; but we may perhaps hope to delay the spread of infection, thus affording better facilities for treatment of the sick, and this is an achievement well worth while.

With reference to scientific investigations, these should not be conditioned on recurrence of the epidemic. Now is the time to inaugurate comprehensive laboratory and field investigations of influenza and pneumonia, to be continued not for a few months, but for a series of years, since a knowledge of influenza during the intervals between epidemics is essential to the understanding of epidemics. In this connection one of the most essential requisites for a better understanding of the disease is better differential diagnosis of endemic influenza with more careful observation and recording of the relatively mild indefinitely diagnosed epidemics of supposed influenza which are noted from time to time in the intervals between definite epidemics. Even in the absence of a definite diagnosis of individual cases, much would be added to the history of influenza by describing such outbreaks more fully and making them matters of more general record.

A RECENT PAMPHLET ON CANCER.

In response to repeated requests the United States Public Health Service has just issued a popular bulletin entitled "Cancer: Facts Which Every Adult Should Know." This 32-page, pocket-size pamphlet, constituting No. 6 of the "Keep Well Series" published by the United States Public Health Service, was prepared in cooperation with the foremost American authorities on cancer, and may therefore be accepted as representing the best scientific information on this important subject.

The bulletin gives in simple language the main facts regarding the prevalence of cancer, discusses three common causes of needless worry, tells how cancer develops, and describes the causative factors and the chief danger signals of the disease. Special attention is devoted to cancers of the breast, uterus, and digestive organs, and to the various forms of external cancer. An emphatic warning is given regarding alleged "cancer cures," and against quacks and patent nostrums. The use of radium and X-rays is discussed. Following is the summary which concludes the bulletin:

1. Cancer at the beginning is usually painless and its onset for this reason is especially insidious and dangerous.